

STANDARD OPERATING PROCEDURE:






Gas cylinders in school science areas

Note: Compressed gas cylinders should be handled only by trained personnel in conjunction with a site specific risk assessment and appropriate Safety Data Sheet (SDS) for the gas in use.

1. Introduction

Many schools use compressed gas cylinders. Some commonly used gases include LPG, O₂, CO₂, He, and compressed air. These gas cylinders are hazardous due to their chemical characteristics, their compressed state and their physical size. The gases within the cylinders vary in chemical properties ranging from inert to explosive. The gas cylinders are made from heavy walled metal that have been manufactured to withstand high pressure. They come in different sizes generally denoted by a letter code. Compressed gases are classified as Class 2 substances in the ADG code and are divided into four sub-classes. The GHS pictogram identifies the hazard class i.e. Gases under Pressure.

Comparison of the GHS Hazard Pictogram and the Corresponding ADG Class Labels

GHS Hazard Pictogram	GHS Hazard	DG Class Labels	DG Sub-Classes
	Gases under Pressure	   	<p>Class 2.1 Flammable Gases: e.g. LPG</p> <p>Class 2.2 Non-flammable, non-toxic and Non-oxidising gases: e.g. CO₂, He and Compressed air.</p> <p>Class 2.2/5.1 Oxidising Gases: e.g. O₂</p> <p>Class 2.3 Toxic Gases: (not used in schools)</p>

Appropriate care in the handling, storage and transportation of gas cylinders is essential.

2. Context

- These instructions are for the use of experienced science teachers and technicians who are properly trained in handling techniques.
- A site-specific risk assessment should be carried out to determine appropriate storage, handling and transport arrangements required by your laboratory.
- Safe operating procedures should be established.
- Information and training in use and hazards of cylinders should be made available.
- Gas equipment operating manuals should be consulted.

3. Safety notes

- Cylinders pose risks relating to the gases they contain:
 - A flammable gas** may cause an explosion or fast spreading fire. Note: Hydrogen is not recommended for use in schools as it is extremely difficult to store safely due to its fire and explosion hazard. It is a highly flammable gas with the potential to form explosive mixtures with air within the range of 4% and 75%. It is much lighter than air and will collect at the highest point within an enclosed space unless ventilated at a high level, which could create an explosive mixture.
 - Oxidizing gases** can accelerate combustion and increase the risk of fire in the presence of combustible or flammable materials.
 - Some gases are toxic** if inhaled. Note: Toxic gases are not suitable for use in schools.
- All gas cylinders pose a threat due to the potential for oxygen depletion, making asphyxiation possible. Use in well ventilated areas and never store or use in confined spaces.
- Some gases are heavier than air and collect in low lying areas, while other gases are lighter than air and collect in high points in enclosed spaces. For any gas in use, check safety information as to whether it is heavier or lighter than air, and subject to pooling in high or low spaces.
- Consult appropriate SDSs for information on the chemical ingredients, physical and health hazards, specific handling and storage information, exposure controls and personal protective measures.
- Any gas cylinder that is exposed to fire or extreme heat may rupture resulting in a rapid release of gas and flying shrapnel. Do not use cylinders that have been heated or exposed to a fire.
- A BLEVE or "boiling liquid expanding vapour explosion" can occur when a cylinder containing a pressurised liquid is ruptured. It can occur in a vessel that stores a substance that is usually a gas at atmospheric pressure but is a liquid when pressurised for example, liquefied petroleum gas (LPG).
- Full and/or empty cylinders should not be stored in science teaching areas unless they are in active use.
- Full and empty cylinders should be segregated.
- Large cylinders are heavy and awkward to move, even when empty and unstable due to their slender shape. Incorrect handling may cause injury, such as sprains, strains, falls, bruises, or broken bones.
- Cylinders contain gas under high pressure. There is a possibility of a cylinder becoming a projectile if it falls over and the valve stem is broken so that there is a rapid escape of the compressed gas.

- Cylinders must be properly secured at all times. See Section 6 for further details
- Only use equipment designed for use with gas cylinders and make sure any attachments are compatible with the cylinder and the specific gas in use.
- The cylinder valve is the primary safety mechanism used to contain the contents of a pressurised cylinder.
- ALWAYS turn off the cylinder valve, not just the regulator when not in use
- For transportation, secure the cylinder upright with a chain or belt and leave the valve protection cap in place. Do not drag or slide the cylinder.
- If private vehicle transportation is required an open back utility vehicle is advisable. DO NOT transport in a passenger compartment.
- Be aware of potential hazards and develop emergency response procedures.

4. Regulations, licences and permits

Consult dangerous goods and local government regulations for storage and transportation legislation.

5. Equipment

- Compressed gas cylinder
- Cylinder key if required
- Compatible regulator
- PPE – lab coat, safety shoes, leather gloves, safety glasses
- Cylinder trolley, if transportation is required

6. Operating procedure

Storage of cylinders

1. Full and/or empty cylinders are not to be stored in labs and should be stored separately; preferably in a dedicated cylinder store which is dry, well ventilated, secure and has clear signage in accordance with regulations. Placard the different storage areas of gases with the GHS pictogram to identify the hazard class 'Gases under Pressure', and the DG class label to identify the contents of the cylinder.
2. Avoid below ground storage areas.
3. Only keep cylinders 'in use' in the lab. Minor storage quantities apply in labs. (Refer to AS 4332 *The Storage and Handling of Gases in Cylinders*).
4. Store and segregate different types of gases in accordance with regulations (refer to State Dangerous Goods Legislation and AS 4332).

Gas cylinders should be segregated from incompatible gases by at least 3 metres. For example Class 2.1 Flammable gases should not be stored with Class 2.2/5.1 oxidising gases and should be stored at least 3 metres from combustible materials.

5. Gases which are denser than air e.g. LPG and CO₂ need to be stored with caution to avoid storage where these gases can collect in low lying areas such as pits, depressions and basements. Ventilation should be provided at floor level.

Operating Procedure continued:

6. Gases much lighter than air e.g. helium, collect at the highest point in any enclosed space. Ventilation should be provided at the highest point of the room.
7. Cylinders must be properly secured to a wall or bench with either a chain or nylon strapping designed for cylinders before any equipment is connected. Restraints should be around the main cylinder body and not the neck. A cylinder trolley is for transport only and should not be used for storage of cylinders
8. Always store cylinders upright, with the valve cap in place on a level floor for easy trolley access and out of traffic areas.
9. Gas cylinders should not be located near heavily travelled areas and any doorway or any other location that could result in the blockage of an exit. Cylinders should be at least 1m away from any opening in a building.
10. Ensure valve guards or caps are fitted when cylinders are not in use to keep the valve clean.
11. Keep all cylinders away from heat sources and any flammable gases away from any ignition sources and electrical outlets.
12. Do not store near combustible materials or flammable liquids.
13. Never hang clothes or equipment on a compressed gas cylinder.

Transporting cylinders

1. Cylinder valves must be closed and regulators and all equipment detached before transportation.
2. Secure cylinder upright to a cylinder trolley when being transported. Seek help if movement requires handling a very large cylinder.
3. Never roll or drag a cylinder on the ground.
4. Once in the lab secure the cylinder to a wall or bench.
5. If private vehicle transport is required, an open back utility vehicle is recommended with cylinders upright and secured. **DO NOT** transport in a passenger compartment.

Handling cylinders

1. Always check the label on the cylinder first to make sure the correct gas is being used.
2. Attach a compatible regulator i.e. appropriate for the gas, pressure and application. A gas cylinder is designed to supply gas through pressure regulators that meet Australian Standards. Regulators bring down the high pressure to a usable working pressure. Do not over tighten or use excessive force as this can damage the thread.
3. Never open a cylinder valve unless the cylinder is connected to a regulator. Open by turning the hand wheel or cylinder key anticlockwise and close by turning clockwise.
4. The valve should not be fully opened to the point of resistance, but given a half turn back to prevent it locking in an open position.

Operating Procedure continued:

5. Flammable gases have a left hand thread to attach the regulator to distinguish them from non-flammable gases.
6. Never use a faulty or leaking regulator.
7. Do not use thread sealing tape or lubricants on cylinder valves and fittings. Regulators should seal properly without either of these.
8. When not in use or when empty, both the cylinder valve and regulator should **ALWAYS** be closed.
9. Use cylinders in well-ventilated areas.
10. Do not use cylinders that show signs of damage or corrosion or when identification tags/labels are missing.

7. Trouble shooting/emergencies

- First aid: See latest SDSs of individual gases for detailed information
- If a small leak is suspected check by listening for a hissing sound, looking for frosting around the valve or testing with a squeeze bottle of soapy water. Bubbles will form where the gas is escaping. If safe to do so, close cylinder valve and refit the regulator.
- If the leak is significant and unstoppable, evacuate the area and call the fire brigade.
- If any cylinder is involved in a fire, evacuate to at least 100m away and call 000, do not attempt to fight the fire.
- Never attempt to repair any cylinders. Any problems should be referred to the supplier.
- Do not over tighten or use excessive force to attach fittings, or attempt to connect an incompatible regulator or fittings as the threads may be damaged.
- All regulators and hoses should be serviced by a professional according to manufacturer's specifications or at least every 5 years.

8. Waste disposal

- All empty or partially filled cylinders should be labelled as empty, set aside from full cylinders and returned to the supplier.

9. Related material

- Risk assessments for individual gas cylinders.
- SDSs for specific gases.
- Gas equipment operating manuals.

References:

'Australian Dangerous Goods Code', National Transport Commission website
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